In single-theodolite work, when a very rapid increase in velocity is encountered, the question arises as to its reality, since it may be explained by faulty ascensional rate of the ballon caused by leaking. In the earlier years of single-theodolite work there was a strong tendency to question the accuracy of what appeared to be an abnormal record, such as a very rapid increase in velocity. In the past three or four years, however, numerous instances in which records like those shown in Figure 1 have been authenticated by the two-theodolite method, together with the now well-known rarity with which leaks develop in balloons, lead to the conclusion that single-theodolite results are dependable, providing reasonable care is taken in preparing the balloon, setting up the theodolite, and reading the angles.

FRUIT-SPRAY AND HARVEST-WEATHER FORECAST WORK OF THE WEATHER BUREAU IN NEW YORK STATE[1]

By E. B. CALVERT

The subject of this paper involves two distinct, though closely related, projects. The Weather Bureau portion of the work is performed at Ithaca, N. Y., and the cooperative features are handled by the officials of the State College of Agriculture and State Extension Service at Ithaca.

The fruit-spray forecast service, principally for apple orchardists in 10 counties near Lake Ontario, begins early in April and extends into the latter part of June.

The harvest-weather forecast work starts in the latter part of June and extends through August, although there is demand and justification for beginning it earlier and terminating it a few weeks later.

THE FRUIT-SPRAY FORECAST SERVICE

This service was begun in 1919 to furnish specialized information as to the coming of rains. While the apple growers suffer serious loss from frost on an average of less than one year in ten, scab is an almost ever-present menace. The spores of this fungus come into activity when moistened, and unless killed by spraying may infect a tree within less than 24 hours. The problem is to apply spray containing poison ingredients just before rains or a prolonged period of moist, misty weather, because the poisons must be present when the spores start to grow. Unless rains or misty weather occur within about three days after spray is applied, the effect of the poison is minimized or lost altogether, but if rains occur and spray has not been applied a season's profit may be turned to loss.

When it is known that about 12,000 commercial apple orchards in 9 counties are equipped for spraying; that, working the limit of daylight hours, two to three days are required for spraying many of the larger orchards; that at least three applications are made in a season; that the total cost during a season for materials and labor alone represents an expenditure of over $3,500,000; and the returns from sales of fruit from properly sprayed trees is often in excess of $100 per acre over that from infected trees, the great responsibility of the forecaster for issuing accurate and timely weather forecasts becomes apparent.

Plant pathologists and entomologists are on duty in nearly all the apple-growing counties during the spraying season for the purpose of watching swelling, budding, and blooming developments and determing when the various orchards are in the proper stages for spraying, This varies according to nearness to the lake, topography, and other conditions. Prior to 1919 these men undertook to interpret the regular weather forecasts and to give spraying advices accordingly. It was apparent, however, that these forecasts should be extended to cover two or three days in order that there might be ample time for applying sprays in the large orchards.

Accordingly, a meteorologist was assigned to the work for the first season, with headquarters at Rochester. Successful demonstrations of the feasibleness of the plan were made. For two or three seasons the State and local extension and farm bureau services met a fair portion of the expenses, it being quite impossible for the Weather Bureau to withdraw enough funds from other activities to carry on the work. Concerted effort on the part of the orchard interests finally secured a small appropriation for the present fiscal year, and the project is now for the first time on what may be considered a permanent basis.

The Weather Bureau portion of the work is conducted from the Weather Bureau office at Cornell University by Mr. J. C. Fisher and his assistant, Mr. C. E. Lamoreaux, under the supervision of Dr. W. M. Wilson, official in charge at Ithaca. A telegram is sent each night during the spraying season from Washington giving the views of the Washington forecaster as to the character of weather to be expected in New York orchard districts for as long a period in advance as the conditions shown on the weather map justify. Mr. Fisher then prepares amplified forecasts, based on the message received from Washington and on his own intimate knowledge of the areas for which the forecasts are made. These forecasts are issued every night by telegraph or telephone to the one or more pathologists and entomologists who are field leaders in the various counties. A telephone relay system is organized in each county, through which all the orchardists whose trees are in a condition for spraying are notified by the field leaders before the following morning.

Demands for similar service have been received from the apple-growing districts of Pennsylvania, Maryland, West Virginia, and Virginia. Some service has been given to these districts, but in no such organized way as in New York. Plans are under way, however, for organizing and extending the work in these States along lines similar to those in New York.

THE HARVEST-WEATHER FORECAST SERVICE

This service, like the fruit-spray service, was conducted as an experiment and demonstration for two or three years. It is really an outgrowth of the other. Credit for its inception belongs to Dr. Wilford M. Wilson. He ascertained that the forecasts made for the benefit of orchardists were also being used by farmers of those sections as a guide in their farming operations and especially in early harvesting. Therefore in the summer of 1921 a direct service to farmers was inaugurated in a few counties for their guidance in the harvesting of hay, oats, wheat, and other crops. The forecasts were prepared and the work done by Mr. M. R. Sanford, in charge of the Weather Bureau office at Syracuse. He performed all the duties connected therewith until this last season, when for administrative reasons it was transferred to Ithaca. It is due largely to Mr. Sanford's energy and ability that the demonstration was so highly successful.

[1] (Read at the meeting of the American Meteorological Society, Jan. 2, 1925, Washington, D. C. The following text is condensed from the original.—*B. M. W.*)

The work was conducted in cooperation with the State Agricultural and Home Bureau officials and county agents, and a part of the expenses were paid by these agencies. The response to the first season's efforts was not only encouraging but surprising, the farmers very evidently appreciating the organization of the service for their benefit. This first season of demonstration showed that the project could not be abandoned. Three years of successful forecast service and the energetic efforts of the people of New York engaged in agricultural extension work had their combined effect, and in the appropriations for the Weather Bureau for the current fiscal year a little less than $10,000 was made available for the harvest-weather and fruit-spray forecasts projects together. The appropriations did not become effective until July 1, 1924, too late to utilize any of it for the fruit-spray work; but in the meantime Doctor Wilson, Mr. Fisher, and the remainder of the force at the Ithaca office worked out a splendid program and organization which were ready to go into action on that date.

The harvest-weather forecast work this year was confined to July and August. It was recognized that it should have been extended into September, but since it was the first year of the expanded and organized service caution in respect to appropriations and expenditures had to be exercised. As a result the bureau kept well within the available funds. Therefore next year, provided telegraph rates remain the same (which now seems very doubtful), additional counties will come within the provisions for service.

The project involves many unique features and in a way marks an epoch in the work of the Weather Bureau in service directly for the benefit of farmers. It is perhaps not so spectacular as the fruit-spray service, but from the standpoint of the number of individuals benefited, aggregate value of the crops affected, and total economic returns in prevention of losses, it far transcends the fruit-spray activities. Therefore, the phrasing and interpretation of the forecasts will be given in some detail.

The system of phrasing the forecasts was designed to meet practical problems in a practical way and is employed invariably and consistently. It corresponds fairly closely to that used in the regular forecasts issued for the general public:

Fair, partly cloudy, or *cloudy* mean: No rain expected.
Rain means: General rain of several hours duration.
Clearing: End of rainy spell is approaching.
Showers: Rain at intervals, probably light.
Thunderstorms: Local thunderstorms; forecaster unable to specify exact time, locality, or intensity.

To the foregoing terms, words are added to indicate the probability of the weather occurring as forecast; that is, the weight that should be given to the day's forecast, as follows:

Strongly indicated: Weight 90 to 100 per cent.
Indicated: Weight 70 to 80 per cent.
Unsettled or *probable:* Weight 50 to 60 per cent.

An example of an actual forecast is: "Good drying weather strongly indicated for Wednesday; also indicated for Thursday; Friday unsettled, probably rain."

Cards explaining the terms used in the forecasts and the weight to be applied were distributed to practically every farmer in the counties concerned. With a forecast such as given in the above-quoted example a farmer could plan his work with reasonable assurance of fine weather for one day and probably two, but must take into account the uncertainty of the third day, for which there was more than an even chance for rain.

During the past season 35 counties were served, representing practically all of the important agricultural sections of the State. Responsible persons having contact with the rural telephone lines were selected to act as distributors of forecasts. They in turn secured the names and addresses of every farmer having telephone service. A notice regarding the service, the card explaining the form and terms of the forecast, and a pamphlet of an educational nature giving elementary facts regarding weather forecasting, the movement of storms, etc., were sent to each of these farmers.

A message, usually telegraphic, but occasionally by telephone, containing forecasts applicable to his section, was sent daily, Sundays excepted, to each distributor, reaching him as a rule before 11 a. m. In most cases the farmers called the distributors between 11 a. m. and 1 p. m., but in some instances the distributors called the subscribers on each line by a significant ring, so that all who desired to do so could listen in while the forecasts were read.

The total number of distributors employed last season was 258, an average of 8 or 9 to a county. In 5 of the 35 counties the distribution was accomplished entirely by radio through the station of the General Electric Co. at Schenectady. The total number of farmers to whom the forecasts were made available, calculated from the number of telephone subscribers and not including the counties covered by radio distribution, was about 24,000.

At the end of the season a questionnaire card was sent to a considerable number of farmers for the purpose of ascertaining the extent to which the service was used, the general accuracy of the forecasts, and soliciting questions and comments as a guide in preparing for the next season's work. Returns were received from 2,218 persons. Of this number 1,907 indicated that they used the forecasts in their harvesting operations and 311 said they did not, but of this latter class 198 said they believed the service would be of value to them and that they intended to try it next year. Only 29 expressed the opinion that it was of no use to them and that they did not want it.

THE CLIMATE OF TRINIDAD, B. W. I. [1]

By PRESTON E. JAMES
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The island of Trinidad, British West Indies, is located about 10° north of the Equator, off the mouth of the Orinoco River. Along the northern coast of the island runs a mountain range, its highest peaks reaching elevations a little over 3,000 feet (900 meters). South of this there are two belts of moderate relief (fig. 1), trending roughly northeast-southwest. Between these belts there are two areas of lower relief, partly a dissected plain, and partly flatlands and swamps. The climate of this island may be classified as a rainy, low-latitude climate, modified by an insular position.

Temperature.—Complete, long-period weather observations are available only for the St. Clair Experiment Station (Port of Spain). This station is located 66.7 feet (20.3 meters) above sea level, on the lee side of the island (fig. 1). Its records go back to 1862, and may be taken as fairly typical of the whole island as regards temperature conditions.

The average annual temperature for the period 1907–1916 was 77.3° F. (25.2° C.). The annual range is char-

[1] Read before the American Meteorological Society, Washington, D. C., Jan 2, 1925. Data from Trinidad official statistics and from observation in the field.